

REMARKS/ARGUMENTS

Claims 1-76 were pending in the present application. Claims 46-76 are withdrawn from consideration. The present response amends claims 1, 7-13, 16, 33, 42, and 45, leaving pending in the application claims 1-45. Reconsideration of the rejected claims is respectfully requested.

I. Restriction Requirement

Applicants affirm the election of the claims in Group I (claims 1-45) without traverse. Claims 46-76 are therefore withdrawn.

II. Rejection under 35 U.S.C. §112

Claims 1-45 are rejected under 35 U.S.C. §112, first paragraph, as not providing enablement for any type of substrate. The Office Action states on page 3 that the specification is “enabling for a semiconductor substrate.” Although Applicants do not necessarily agree with the rejection, claim 1 has been amended to specifically recite a semiconductor substrate in order to expedite issuance of the pending claims. Claims 2-45 depend from claim 1 and should also be sufficiently enabled. As such, it is respectfully requested that the rejection with respect to claims 1-45 be withdrawn.

Claims 1-45 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Particularly, claim 1 is rejected as failing to recite a positive step of removing the photoresist. Although Applicants do not necessarily agree with the rejection, claim 1 has been amended to recite such a positive step for purposes of clarity and to expedite issuance of the pending claims. Claim 1 and dependent claims 2-45 should therefore be sufficiently definite.

Claims 7-13 are rejected as being indefinite. Claim 7 is rejected for reciting an element not included in the Markush group of claim 3. As claim 7 does not depend from claim 3, Applicants respectfully submit that the rejection is improper. Claims 7-13 also are rejected for not specifying whether an element is one of the elements of claim 1 or an additional element. Claims 7-13 have been amended to identify that the claimed elements are included in the high dipole moment solvent of claim 1. Claims 7-13 therefore should be sufficiently definite.

Further, claim 16 is rejected as being indefinite for being unclear as to the units of the concentration percentage. Claim 16 has been amended to specify that the percentage is a volume

percentage for purposes of clarity. It is respectfully submitted that in the industry the hydrogen peroxide concentration in such an application is always defined in terms of percentage by volume, and that the addition of such a limitation to the claim does not add new matter to the disclosure. Further, the specification on pages 12-13 cites many usages of the volume percentage of hydrogen peroxide. Claim 16 should therefore be sufficiently definite.

Claims 34-35 are rejected as being indefinite for lacking proper antecedent basis for the term “second co-solvent mixture.” Claims 34-35 depend from claim 33, which has been amended to clarify that the “second mixture” is a “second co-solvent mixture.” This amendment would have been obvious in light of the claim language and of the specification, such that the amendment does not add new matter to the specification. This amendment also provides sufficient antecedent basis for the term “second co-solvent mixture” in claims 34-35. Claims 34-35 should therefore be sufficiently definite.

Claim 40 is rejected as being indefinite for being unclear as to the meaning of a “high” dielectric constant gate material. Applicants respectfully disagree that the term is unclear, as the term is well understood in industry. Further, the term “high dielectric (“high k”) gate material” is defined in the specification on page 17 to refer to materials having a dielectric constant on the order of the dielectric constant of materials such as hafnium oxide, platinum, and zirconium oxide. As such, it is respectfully submitted that the term “high dielectric constant gate material” is sufficiently definite.

Claim 42 is rejected as lacking proper antecedent basis for the term “DUV photoresist.” Claim 42 has been amended to ensure proper antecedent basis, and as such should be sufficiently definite.

Claim 45 is rejected as lacking proper antecedent basis. Claim 45 has been amended to properly depend from claim 2, and should be sufficiently definite.

Applicants therefore respectfully request that the §112, second paragraph, rejections with respect to claims 1-45 be withdrawn.

III. Rejection under 35 U.S.C. §102

Claims 1-7, 9, 13-14, 17-18, 20-24, 27, 29-32, and 45 are rejected under 35 U.S.C. §102(e) as being anticipated by *Xu* (US 2003/0125225). Claim 1 as amended recites a method of removing photoresist and/or resist residue from a semiconductor substrate, defined by:

(a) providing a semiconductor substrate having photoresist material formed thereon; and
(b) removing at least a portion of the photoresist material by **exposing the substrate to a co-solvent mixture comprising a high dipole moment solvent, an oxidizer, and an accelerator**, wherein the oxidizer is selected to dissolve bonds in the photoresist material, whereby the accelerator is selected to increase a rate of removal of the photoresist, and whereby the co-solvent mixture dissolves the photoresist material in a substantially layer-by-layer manner at a substantially single pressure.

(*emphasis added*). *Xu* does not disclose such a method.

Xu discloses lists of materials that can be used with a supercritical fluid to remove photoresist material, including “surfactants, chelating agents and/or chemical reactants such as acids/bases or oxidants/reductants;” and lists of active agents such as “acids, bases, reducing agents, and oxidizing agents” (paragraphs 34-45). The mere recitation of the use of oxidants with supercritical fluids is not sufficient to anticipate claim 1, however. Oxidants have been used prior to the disclosure in *Xu* without success, and *Xu* has not disclosed or taught how these oxidants can be used successfully. Oxidants are presently used sparingly in supercritical cleaning because the oxidizers become extremely reactive, often attacking the substrate and supercritical vessel in addition to the photoresist. Further, the depressurization of the supercritical chamber can form shock sensitive products in large enough concentration to cause explosions. If *Xu* had actually obtained the invention recited in claim 1, *Xu* would have discovered that the photoresist can be removed without pressure cycling or pulsed operation, which *Xu* recites in paragraph 61 and claim 69 as being potentially necessary to remove all the photoresist. *Xu* does not disclose, teach, or suggest that the photoresist can be dissolved at a substantially single pressure, as required by claim 1. It is disclosed in the present application that oxidizers can be selected and used in large concentrations that dissolve the bonds in the photoresist, such that the co-solvent mixture dissolves the photoresist layer-by-layer and without pressure cycling (see e.g., Pat. App. p. 37, lines 5-14). *Xu* does not disclose such selection, concentration, and abilities when using oxidizers.

Xu also does not teach or suggest that the surfactants and/or chelating agents listed in the *Xu* application can be used as an accelerating agent as suggested in the Office Action on p. 5. Claim 1 requires that the accelerator be selected to increase a rate of removal of the photoresist. There is no teaching or suggestion in *Xu* that the surfactants and/or chelating agents serve such a purpose. Further, *Xu* does not disclose, teach, or suggest “exposing the substrate to a co-solvent mixture comprising a high dipole moment solvent, an oxidizer, and an accelerator, wherein the

oxidizer is selected to dissolve bonds in the photoresist material, whereby the accelerator is selected to increase a rate of removal of the photoresist, and whereby the co-solvent mixture dissolves the photoresist material in a substantially layer-by-layer manner at a substantially single pressure” as required by claim 1. As such, claim 1 cannot be anticipated by *Xu*. Claims 2-7, 9, 13-14, 17-18, 20-24, 27, 29-32, and 45 depend from claim 1 and also cannot be anticipated by *Xu*. Applicants therefore respectfully request that the rejection with respect to claims 1-7, 9, 13-14, 17-18, 20-24, 27, 29-32, and 45 be withdrawn.

IV. Rejection under 35 U.S.C. §103

Claims 1-7, 9, 13-14, 17-18, 20-22, 24, 29-40, and 42-45 are rejected under 35 U.S.C. §103(a) as being obvious over *Mullee* (US 6,500,605) in view of *Xu*. *Mullee* teaches removing photoresist from a substrate using a supercritical fluid, an amine, and a solvent (Abstract; col. 4, lines 30-60). *Mullee* does not teach or suggest using an oxidizer as required by claim 1, nor dissolving the photoresist material using a co-solvent mixture comprising a high dipole moment solvent, an oxidizer, and an accelerator. *Mullee* therefore cannot render claim 1 obvious. *Xu* does not make up for the deficiencies in *Mullee* with respect to claim 1 for reasons including those discussed above. Particularly, *Xu* does not teach or suggest that photoresist can be dissolved from a substrate by exposing the substrate to a co-solvent mixture comprising a high dipole moment solvent, an oxidizer selected to dissolve bonds in the photoresist material, and an accelerator selected to increase a rate of removal of the photoresist, whereby the co-solvent mixture dissolves the photoresist material in a substantially layer-by-layer manner at a substantially single pressure. Further, there would have been no motivation to combine an oxidizer with the invention of *Mullee*, as the use of oxidizers is presently limited in supercritical applications for reasons including those discussed above, such as the problem with the oxidizer attacking the substrate and chamber in addition to the photoresist. As such, Applicants respectfully submit that independent claim 1, as well as dependent claims 2-7, 9, 13-14, 17-18, 20-22, 24, 29-40, and 42-45, is not rendered obvious by *Mullee* and *Xu*. Applicants therefore respectfully request that the rejection with respect to claims 1-7, 9, 13-14, 17-18, 20-22, 24, 29-40, and 42-45 be withdrawn.

Claims 8-12 are rejected under 35 U.S.C. §103(a) as being obvious over *Mullee* in view of *Xu* and further in view of *Bhatt* (US 5,637,442). Claim 1 is not rendered obvious by *Mullee*

and *Xu* for reasons including those discussed above, and *Bhatt* does not make up for the deficiencies in this combination. *Bhatt* is cited as teaching the use of organic solvents such as benzyl alcohol in combination with supercritical fluid for etching wafer surfaces (OA p. 7). *Bhatt* does not teach or suggest, however, removing at least a portion of the photoresist material by exposing the substrate to a co-solvent mixture comprising a high dipole moment solvent, an oxidizer, and an accelerator, wherein the oxidizer is selected to dissolve bonds in the photoresist material, whereby the accelerator is selected to increase a rate of removal of the photoresist, and whereby the co-solvent mixture dissolves the photoresist material in a substantially layer-by-layer manner at a substantially single pressure. As such, *Bhatt* cannot render claim 1, or dependent claims 8-12, obvious, either alone or in any combination with *Mullee* and *Xu*. Applicants therefore respectfully request that the rejection with respect to claims 8-12 be withdrawn.

Claims 15-16 are rejected under 35 U.S.C. §103(a) as being obvious over *Mullee* in view of *Xu* and further in view of *Marquis* (US 6,040,284). Claim 1 is not rendered obvious by *Mullee* and *Xu* for reasons including those discussed above, and *Marquis* does not make up for the deficiencies in this combination. *Marquis* is cited as teaching oxidizing agents such as hydrogen peroxide, having a concentration of 30-50% for purposes of enhancing stripping of a substrate (OA p. 7). *Marquis* is directed to stripping paint (Abstract; col. 1, lines 31-58), and as such is non-analogous prior art. There is no teaching or suggestion that a material used to strip paint would be effective in removing photoresist from a semiconductor substrate. Further, *Marquis* does not teach or suggest that photoresist material can be dissolved by exposing the substrate to a supercritical fluid in combination with a co-solvent mixture comprising an organic solvent and an oxidizer selected to dissolve cross-linked bonds in the photoresist material, whereby the co-solvent mixture dissolves the photoresist material in a substantially layer-by-layer manner at a substantially single pressure. Further still, the ranges cited in the Office Action and in *Marquis* are different than the range recited in claim 16. As such, *Marquis* cannot render claim 1, or dependent claims 15-16, obvious, either alone or in any combination with *Mullee* and *Xu*. Applicants therefore respectfully request that the rejection with respect to claims 15-16 be withdrawn.

Claims 19 is rejected under 35 U.S.C. §103(a) as being obvious over *Mullee* in view of *Xu* and further in view of *Honda* (US 6,413,923). Claim 1 is not rendered obvious by *Mullee*

and *Xu* for reasons including those discussed above, and *Honda* does not make up for the deficiencies in this combination. *Honda* is cited as teaching formic and acetic acids as equivalent acids for removing residue from the wafer surface fluid (OA p. 8). *Honda* does not teach or suggest, however, removing at least a portion of the photoresist material by exposing the substrate to a co-solvent mixture comprising a high dipole moment solvent, an oxidizer, and an accelerator, wherein the oxidizer is selected to dissolve bonds in the photoresist material, whereby the accelerator is selected to increase a rate of removal of the photoresist, and whereby the co-solvent mixture dissolves the photoresist material in a substantially layer-by-layer manner at a substantially single pressure. As such, *Honda* cannot render claim 1, or dependent claim 19, obvious, either alone or in any combination with *Mullee* and *Xu*. Applicants therefore respectfully request that the rejection with respect to claim 19 be withdrawn.

Claim 23 is rejected under 35 U.S.C. §103(a) as being obvious over *Mullee* in view of *Xu* and further in view of *Gotkis* (US 6,328,042). Claim 1 is not rendered obvious by *Mullee* and *Xu* for reasons including those discussed above, and *Gotkis* does not make up for the deficiencies in this combination. *Gotkis* is cited as teaching the cleaning of wafers using various types of solvents, dependent upon the type of contaminant present (OA p. 9). *Gotkis* does not teach or suggest, however, removing at least a portion of the photoresist material by exposing the substrate to a co-solvent mixture comprising a high dipole moment solvent, an oxidizer, and an accelerator, wherein the oxidizer is selected to dissolve bonds in the photoresist material, whereby the accelerator is selected to increase a rate of removal of the photoresist, and whereby the co-solvent mixture dissolves the photoresist material in a substantially layer-by-layer manner at a substantially single pressure. As such, *Gotkis* cannot render claim 1, or dependent claim 23, obvious, either alone or in any combination with *Mullee* and *Xu*. Applicants therefore respectfully request that the rejection with respect to claim 23 be withdrawn.

Claims 25 and 27-28 are rejected under 35 U.S.C. §103(a) as being obvious over *Mullee* in view of *Xu* and further in view of *Davenhall* (US 6,403,544). Claim 1 is not rendered obvious by *Mullee* and *Xu* for reasons including those discussed above, and *Davenhall* does not make up for the deficiencies in this combination. *Davenhall* is cited as teaching the addition of additives such as propylene glycol methyl ether to the supercritical fluid for purposes of enhancing the cleaning process (OA p. 9). *Davenhall* does not teach or suggest, however, removing at least a portion of the photoresist material by exposing the substrate to a co-solvent mixture comprising a

high dipole moment solvent, an oxidizer, and an accelerator, wherein the oxidizer is selected to dissolve bonds in the photoresist material, whereby the accelerator is selected to increase a rate of removal of the photoresist, and whereby the co-solvent mixture dissolves the photoresist material in a substantially layer-by-layer manner at a substantially single pressure. As such, *Davenhall* cannot render claim 1, or dependent claim 23, obvious, either alone or in any combination with *Mullee* and *Xu*. Applicants therefore respectfully request that the rejection with respect to claims 25 and 27-28 be withdrawn.

Claim 41 is rejected under 35 U.S.C. §103(a) as being obvious over *Mullee* in view of *Xu* and further in view of *DeYoung* (US 6,669,785). Claim 1 is not rendered obvious by *Mullee* and *Xu* for reasons including those discussed above, and *DeYoung* does not make up for the deficiencies in this combination. *DeYoung* is cited as a supercritical fluid in combination with co-solvents can be used to clean a substrate having an anti-reflective layer (OA p. 10). *DeYoung* does not teach or suggest, however, removing at least a portion of the photoresist material by exposing the substrate to a co-solvent mixture comprising a high dipole moment solvent, an oxidizer, and an accelerator, wherein the oxidizer is selected to dissolve bonds in the photoresist material, whereby the accelerator is selected to increase a rate of removal of the photoresist, and whereby the co-solvent mixture dissolves the photoresist material in a substantially layer-by-layer manner at a substantially single pressure. As such, *DeYoung* cannot render claim 1, or dependent claim 23, obvious, either alone or in any combination with *Mullee* and *Xu*. Applicants therefore respectfully request that the rejection with respect to claim 41 be withdrawn.

V. Amendment to the Claims

Unless otherwise specified, amendments to the claims are made for purposes of clarity, and are not intended to alter the scope of the claims or limit any equivalents thereof. The amendments are supported by the specification and do not add new matter to the specification.

VI. Conclusion

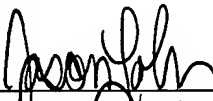
In view of the above, it is respectfully submitted that the application is now in condition for allowance. Reconsideration of the pending claims and a notice of allowance is respectfully requested.

The Commissioner is hereby authorized to charge any deficiency in the fees filed, asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 50-1703, under Order No. SCP-9410. **A duplicate copy of the transmittal cover sheet attached to this Response to Office Action Mailed June 28, 2004, is provided herewith.**

Respectfully submitted,

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